

gas outlet (on-axis) extending in an axial direction perpendicular to the exposed surface of the substrate." Figures 2a-2c show an example of an "on-axis" outlet 24 (see specification at page 12, lines 2-5). Accordingly, the recitation of the "on-axis" outlet in Claim 4 is fully described in the specification and the metes and bounds of the claim language can be readily ascertained by a person of ordinary skill in the art. Withdrawal of the rejection is respectfully requested.

Rejection 2

Claims 1-4, 6, 8 and 10-14 were rejected under 35 U.S.C. § 103(a) over commonly owned WO 00/41212 to Ni et al. ("Ni") in view of U.S. Patent No. 4,980,204 to Fujii et al. ("Fujii"). The reasons for the rejection are stated at pages 3 and 4 of the Official Action. The Official Action alleges that it would have been obvious to combine Fujii's apparatus having a plurality of gas outlets with the gas injector of Ni. The rejection is respectfully traversed.

Independent Claims 1 and 10 recite a plasma processing system, which comprises, *inter alia*, the features of a gas injector "extending through the dielectric member such that a distal end of the gas injector is exposed within the processing chamber...the *gas injector including a plurality of gas outlets* supplying process gas at flow rates that are *independently varied* between at least some of the outlets into the processing chamber." (emphasis added). Ni and Fujii fail to suggest the combinations of features recited in Claims 1 and 10.

The Official Action asserts that Ni shows the invention substantially as claimed, including a gas injector 22. However, the Official Action acknowledges that Ni "fails to

expressly disclose a gas injector including a plurality of gas outlets supplying gas at flow rates that are independently varied and wherein the gas outlets are supplied process gas by a single gas supply" (Official Action at page 4).

The Official Action asserts that Fujii discloses a gas injector having a plurality of outlets 111-114 connected to a single gas supply line and that independent flow rate control is provided by gas flow control valves 13-16. It is further asserted in the Official Action that it would have been obvious to one having ordinary skill in the art to have modified the apparatus of Ni to include the gas injector structure of Fujii. Applicants respectfully disagree with these assertions for the following reasons.

Claims 1 and 10 are directed to a gas injector including a plurality of gas outlets, *i.e.*, a single gas injector that includes a plurality of gas outlets. Fujii does not disclose or suggest a gas injector having a plurality of gas outlets, but rather Fujii discloses a plurality of separate vent pipes 111-114 (See Fujii at column 4, lines 30-31 and Figure 3). Because Fujii clearly does not suggest a single injector that includes a plurality of gas outlets, the combination of Ni and Fujii does not provide the necessary incentive or motivation to modify Ni in the manner suggested in the Official Action.

As explained at MPEP § 2143.01 (Eighth Edition, August 2001), page 2100-123, even if the combination of references teaches every element of the claimed invention, without a motivation to combine, a rejection based on a *prima facie* case of obviousness is improper. In the present case, Fujii provides no motivation to modify Ni to attempt to achieve the plasma processing system recited in independent Claims 1 and 10. Moreover, even if Ni and Fujii were improperly combined, the resulting combination still would not

include each and every feature recited in Claims 1 and 10. Accordingly, the rejection is improper and should be withdrawn.

Rejection 3

Claim 5, 7 and 9 were rejected under 35 U.S.C. § 103(a) over Ni and Fujii in further view of U.S. Patent No. 5,160,543 to Ishihara et al. ("Ishihara"). The reasons for the rejection are stated at page 5 of the Official Action. Specifically, the Official Action alleges that it would have been obvious to combine the gas injector configuration of Ishihara with the apparatus of Ni as modified by Fujii. The rejection is respectfully traversed.

Claim 5, which depends from Claim 1, recites, *inter alia*, a gas injector extending through the dielectric member such that a distal end of the gas injector is exposed within the processing chamber, the gas injector including a plurality of gas outlets supplying process gas at *flow rates that are independently varied between at least some of the outlets* into the processing chamber, the gas outlets being supplied process gas by a single gas supply, wherein the gas outlets include a center gas outlet extending in an axial direction perpendicular to the exposed surface of the substrate and a plurality of angled gas outlets extending at an acute angle to the axial direction, the center gas outlet receiving process gas supplied by a first gas line and the angled gas outlets receiving process gas from a second gas line, the first and second gas lines receiving process gas from the *single gas supply*.

As acknowledged in the Official Action, Ni fails to disclose or suggest a gas injector "including a plurality of gas outlets supplying gas at flow rates that are independently varied and wherein the gas outlets are supplied process gas by a single gas supply." As

discussed above, both Ni and Fujii fail to disclose *a gas injector* including a plurality of gas outlets supplying gas at flow rates that are *independently varied* from a single gas supply.

Ishihara fails to remedy the deficiencies of Ni and Fujii. Ishihara discloses an apparatus that includes gas introducing pipes 209, 210 and a gas introducing port 211 (See column 5, lines 55-68). However, gas is supplied to gas introducing pipe 209 via gas feeding pipeline 223, which is supplied gas from gas bombs 201, 202, and gas is supplied to gas introducing pipe 210 via gas feeding pipeline 224, which is supplied gas from gas bombs 203-205 (See column 6, lines 1-3 and Figure 2). Accordingly, the combination of Ishihara with Ni and Fujii does not produce an injector having a plurality of gas outlets which are supplied process gas at flow rates that are *independently varied* from a single gas supply, as recited in Claim 5. For at least the foregoing reasons, Claim 5 is deemed to be patentable over the combination of Ni, Fujii and Ishihara.

Claim 7 recites a plasma processing system, which comprises, *inter alia*, a gas injector including a planar axial end face having an on-axis outlet therein and a conical side surface having off-axis outlets therein, the on-axis outlet receiving process gas from a central passage in the injector and the off-axis outlets receiving process gas from an annular passage surrounding the central passage, *the gas injector supplying process gas at flow rates that are independently varied between at least some of the outlets* including the on-axis outlet into the processing chamber (emphasis added). Ni, Fujii and Ishihara fail to suggest the plasma processing system recited in Claim 7 for the following reasons.

As acknowledged in the Official Action, Ni fails to disclose or suggest a gas injector "including a plurality of gas outlets supplying gas at flow rates that are independently

varied and wherein the gas outlets are supplied process gas by a single gas supply." The gas injector 22 shown in Fig. 3A of Ni referred to in the Official Action includes central bore 44 and gas outlets 46, all of which are in fluid communication with the central bore. Ni does not disclose a conical surface having off-axis outlets therein, as recited in Claim 7. Ni also does not disclose "off-axis outlets receiving process gas from an annular passage surrounding the central passage," as recited in Claim 7.

Fujii fails to cure the deficiencies of Ni with respect to the plasma processing system recited in Claim 7. As discussed above, Fujii does not suggest a single injector that includes a plurality of gas outlets. Accordingly, Fujii does not suggest a gas injector including an on-axis outlet *and* off-axis outlets, as recited in Claim 7. Furthermore, Fujii does not suggest the feature of "the gas injector supplying process gas at flow rates that are independently varied between at least some of the outlets including the on-axis outlet into the processing chamber," as recited in Claim 7. As such, combining Fujii with Ni does not suggest the combination of features recited in Claim 7.

Ishihara fails to cure the deficiencies of Ni and Fujii with respect to the plasma processing system recited in Claim 7. Ishihara does not disclose a gas injector having a conical side surface having off-axis outlets therein. Ishihara discloses a double concentric arrangement structure for introducing gases from separate gas bombs (See column 5, lines 54-63; column 6 lines 55-61 and Figures 2-3). The gas introducing port of Ishihara constitutes the tip portions of the gas pipes (See column 5, lines 59-61 and column 6, lines 62-66). Furthermore, Ishihara does not suggest the feature of "the gas injector supplying process gas at flow rates that are independently varied between at least some of the outlets

including the on-axis outlet into the processing chamber." Accordingly, the combination of Ni, Fujii and Ishihara does not suggest the combination of features recited in Claim 7 which includes the *gas injector including a planar axial end face having an on-axis outlet therein and a conical side surface having off-axis outlets therein*, the on-axis outlet receiving process gas from a central passage in the injector and the off-axis outlets receiving process gas from an annular passage surrounding the central passage, the gas injector supplying process gas at *flow rates that are independently varied* between at least some of the outlets (emphasis added). Thus, the combination of features recited in Claim 7 is patentable over Ni, Fujii Ishihara.

Claim 9 recites a plasma processing system, which comprises, *inter alia*, a gas injector including at least one *on-axis outlet which injects process gas in an axial direction perpendicular to a plane parallel to an exposed surface of the substrate* and *off-axis gas outlets which inject process gas at an acute angle relative to the plane parallel to the exposed surface of the substrate*, the gas injector supplying process gas at *flow rates that are independently varied* between at least some of the outlets into the processing chamber (emphasis added). Ni, Fujii and Ishihara fail to suggest the plasma processing system recited in Claim 9 for the following reasons.

Ni fails to suggest a gas injector including at least one on-axis outlet and off-axis outlets that supply process gas at flow rates that are independently controlled.

Fujii and Ishihara fail to cure the deficiencies of Ni with respect to the plasma processing system recited in Claim 9. As discussed above, neither Ni, Fujii nor Ishihara suggest the combination of features recited in Claim 9 which includes a "gas injector

supplying process gas at *flow rates that are independently varied* between at least some of the outlets." As such, the combination of Ni, Fujii and Ishihara cannot possibly suggest the combination of features recited in Claim 9 which includes "at least one on-axis outlet...and off-axis outlets...the gas injector supplying process gas at *flow rates that are independently varied between at least some of the outlets* into the processing chamber."

Rejection 4

Claim 15 was rejected under 35 U.S.C. § 103(a) over Ni in view of Fujii and further in view of U.S. Patent No. 6,287,643 to Powell et al. ("Powell"). The reasons for the rejection are stated at pages 5-6 of the Official Action. Specifically, the Official Action alleges that it would have been obvious to combine the conducting shield of Powell with the injector apparatus of Ni and Fujii. The rejection is respectfully traversed.

Powell was cited in the Official Action for the disclosure of a gas injection tube 84 provided with an electrically conductive shield. It is not seen, however, how Powell can be combined with Ni absent impermissible hindsight. Powell discloses a remote plasma source 70 comprising an outer tube 72 used for plasma confinement and excitation, and an inner coaxial tube 84 used for importing gas to the chamber (See column 8, lines 13-18). An external RF coil 78 is wound about the plasma confinement tube 72 (See column 8, lines 37-38). Ni discloses a gas injector centrally mounted in a plasma etch reactor wherein a plasma is confined in an area above the substrate (See Ni at page 9, lines 8-22). The Official Action has not set forth a tenable basis establishing the requisite motivation to combine Powell with Ni and Fujii in a manner that would produce the claimed system. However, even if Powell is combined with the injector of Ni, the resulting combination

fails to produce the plasma processing system recited in Claim 1, from which Claim 15 depends. Accordingly, the combination of features recited in Claim 15 is patentable over Ni, Fujii and Powell. Therefore, withdrawal of the rejection is respectfully requested.

Rejection 5

Claims 1-4, 6, 8 and 10-14 were rejected under 35 U.S.C. § 103(a) over Ni in view of Fujii in further view of U.S. Patent No. 4,105,810 to Yamazaki et al. ("Yamazaki"). The reasons for the rejection are stated at pages 6-8 of the Official Action. The Official Action alleges that it would have been obvious to combine Yamazaki's apparatus having a plurality of gas outlets with the gas injector of Ni. Also the Official Action alleges that it would have been obvious to have a single gas supply line connected to independent gas outlets. The Official Action further alleges that it would have been obvious to add the gas flow controllers of Fujii to the apparatus of Ni modified by Yamazaki. The rejection is respectfully traversed.

The deficiencies of Ni and Fujii with respect to the combination of features recited in Claims 1 and 10 are discussed above. Yamazaki fails to cure the deficiencies of Ni and Fujii, as explained below.

The Official Action asserts that Yamazaki discloses an apparatus comprising a gas injector having a plurality of gas outlets that are independently connected to a single gas supply line (See Official Action at page 7). Applicants respectfully disagree. Yamazaki discloses an apparatus having an oxygen source 1 and a carrier gas source 2 (See column 6, lines 47-57 and Figure 1). The carrier gas is used to transport raw materials of zinc, silicon and boron to a reactor (See column 6, lines 47-57 and Figure 1). According to

Yamazaki, however, "it is necessary that at least the raw material vapor for zinc be supplied through a feeding path separated independently from oxygen" (*i.e.*, that the "compound of zinc be separated so that it may not contact with oxygen and other raw materials in the pass from raw material evaporator to the reaction place"). (See column 4, lines 37-40 and column 5, lines 46-50). Thus, Yamazaki fails to disclose a "gas injector including a plurality of outlets supplying process gas at flow rates that are *independently varied between at least some of the outlets* into the processing chamber, the gas outlets being supplied process gas *by a single gas supply*" as recited in independent Claims 1 and 10. Accordingly, Ni, Fujii and Yamazaki fail to suggest the combinations of features recited in Claims 1 and 10, as well as in the claims dependent therefrom. Withdrawal of the rejection is respectfully requested.

Rejection 6

Claim 15 was rejected under 35 U.S.C. § 103(a) over Ni in view of Yamazaki and Fujii and further in view of Powell. The reasons for the rejection are stated at pages 8-9 of the Official Action. Specifically, the Official Action alleges that it would have been obvious to combine the conducting shield of Powell with the injector apparatus of Ni, Yamazaki and Fujii. The rejection is respectfully traversed.

As explained above, Powell fails to cure the deficiencies of Ni and Fujii with respect to the plasma processing system recited in Claim 1, from which Claim 15 depends. The Official Action fails to establish the requisite motivation for selecting the isolated teaching in Powell and adding it to Ni. Accordingly, the combination of features recited in

Claim 15 is patentable over Ni, Yamazaki, Fujii and Powell. Therefore, withdrawal of the rejection is respectfully requested.

Rejection 7

Claims 1-14 were rejected under 35 U.S.C. § 103(a) over Ni in view of Ishihara and Fujii. The reasons for the rejection are stated at pages 9-11 of the Official Action. The Official Action alleges that it would have been obvious to modify the apparatus of Ni with the gas injector structure of Ishihara. The Official Action also alleges that it would have been obvious to modify the apparatus of Ni as modified by Ishihara to further comprise the gas flow controller of Fujii, and alleges that it would have been obvious to have made a single gas supply line connected to independent gas outlets. The rejection is respectfully traversed.

The combination of Ni, Ishihara and Fujii was also applied against Claims 5, 7 and 9 (see above discussion under "Rejection 3"). As explained therein, Ishihara fails to cure the deficiencies of Ni and Fujii as applied to Claims 1 and 10.

Claim 1 recites a plasma processing system comprising a plasma processing chamber; a vacuum pump connected to the processing chamber; a substrate support on which a substrate is processed within the processing chamber; a dielectric member having an interior surface facing the substrate support, wherein the dielectric member forms a wall of the processing chamber; a gas injector extending through the dielectric member such that a distal end of the gas injector is exposed within the processing chamber, the *gas injector including a plurality of gas outlets supplying process gas at flow rates that are independently varied between at least some of the outlets* into the processing chamber, the

gas outlets being supplied process gas by a single gas supply; and an RF energy source which inductively couples RF energy through the dielectric member and into the chamber to energize the process gas into a plasma state to process the substrate.

Claim 10 recites a plasma processing system comprising a plasma processing chamber; a vacuum pump connected to the processing chamber; a substrate support on which a substrate is processed within the processing chamber; a dielectric member having an interior surface facing the substrate support, wherein the dielectric member forms a wall of the processing chamber; a gas injector removably mounted in an opening in the dielectric member and extending through the dielectric member such that a distal end of the gas injector is exposed within the processing chamber, a vacuum seal being provided between the gas injector and the dielectric window, *the gas injector including a plurality of gas outlets supplying process gas at flow rates that are independently varied between at least some of the outlets* into the processing chamber; and an RF energy source which inductively couples RF energy through the dielectric member and into the chamber to energize the process gas into a plasma state to process the substrate.

Ishihara does not suggest the feature of a gas injector including a plurality of gas outlets supplying process gas at flow rates that are *independently varied* between at least some of the outlets gas. Accordingly, the combinations of features recited in Claims 1-14 are patentable over Ni, Ishihara and Fujii. Withdrawal of the rejection is respectfully requested.

Rejection 8

Claim 15 was rejected under 35 U.S.C. § 103(a) over Ni in view of Ishihara and Fujii and further in view of Powell. The reasons for the rejection are stated at pages 11-12 of the Official Action. Specifically, the Official Action alleges that it would have been obvious to combine the conducting shield of Powell with the injector apparatus of Ni, Ishihara and Fujii. The rejection is respectfully traversed.

As explained above, Powell fails to cure the deficiencies of Ni and Fujii with respect to the plasma processing system recited in Claim 1, from which Claim 15 depends. Accordingly, at least for the reasons discussed above, the combination of features recited in Claim 15 is patentable over Ni, Ishihara, Fujii and Powell. Therefore, withdrawal of the rejection is respectfully requested.

It is submitted that the differences between the claimed subject matter and the prior art are such that the claimed subject matter, as a whole, would not have been obvious at the time the invention was made to a person having ordinary skill in the art.

In view of the foregoing, it is submitted that the present application is in condition
for allowance and such action is earnestly solicited.

Respectfully submitted,

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